C.). The maximum allowed temperature may be set by a designer or engineer in light of various factor, such as user comfort and safety.

[0069] If the estimated skin temperature does not exceed the temperature threshold, the method **600** returns to action **602**, where the system reads TSENS. On the other hand, if the estimated skin temperature does exceed the threshold, the method **600** includes mitigating a performance of the processor chip in response to the estimated skin temperature and the threshold.

[0070] For instance, in the example of FIG. **3**, thermal management unit **335** compares the estimated skin temperature to the programmed threshold. If the temperature information indicates that the temperature of the temperature sensor is greater than the threshold, then the thermal management unit **335** may reduce an operating parameter of the processor chip. An example of a processor chip is SOC **230** of FIG. **2**, although the principles described herein may be applied to any appropriate computer processor.

[0071] Action **607** includes reducing an operating parameter of the processor chip. In one example, the thermal management unit **335** reduces an operating frequency of one or more cores in the SOC, thereby reducing power consumption. However, action **607** may include any appropriate thermal mitigation technique, such as putting cores in an idle state. For instance, in the example of FIG. **3**, thermal management unit **335** may send commands to clock control unit **312** to reduce the clock frequency or gate the clock frequency altogether. In fact, reduction of any operating parameter, such as frequency or voltage, is within the scope of embodiments. The process continues to operate as the SOC operates, continually measuring the power consumption and taking appropriate mitigation steps according to the algorithm.

[0072] The scope of embodiments is not limited to the specific method shown in FIG. **6**. Other embodiments may add, omit, rearrange, or modify one or more actions. For instance, method **600** may also include functionality to return the clock frequency to a previous level or otherwise to increase the clock frequency when thermal mitigation is no longer desired, such as after determining that the estimated skin temperature has decreased beyond the same or a different threshold. Also, various embodiments may include taking multiple temperature readings from various temperature sensors spread throughout the package and perhaps the SOC itself, as illustrated by sensors **245***a-c* in FIG. **2**.

[0073] Various embodiments may provide one or more advantages over conventional solutions. For instance, it may be difficult to capture a temperature reading directly from the skin of a computing device, especially for more compact and mobile computing devices such as phones and tablets. Nevertheless, skin temperature can be very relevant to a user's perception of comfort. Some conventional solutions use temperature readings gathered from sensors on the processor chip and base thermal mitigation decisions on that temperature reading without further processing. But temperature readings gathered from thermal sensors on the processor may not provide an accurate indication of skin temperature, thereby causing intervention of a thermal mitigation process too early or too often and sacrificing performance of the system.

[0074] By contrast, the systems described herein provide thermal mitigation using estimated device skin temperatures. The estimation of device skin temperatures may be quite accurate and representative of true device skin temperature, if the parameters of the transfer function and threshold(s) are appropriately calculated during design and/or testing. Some embodiments described herein may improve the operation of a processor chip by allowing for more accurate thermal management, thereby providing comfort and safety for human users.

[0075] As those of some skill in this art will by now appreciate and depending on the particular application at hand, many modifications, substitutions and variations can be made in and to the materials, apparatus, configurations and methods of use of the devices of the present disclosure without departing from the spirit and scope thereof. In light of this, the scope of the present disclosure should not be limited to that of the particular embodiments illustrated and described herein, as they are merely by way of some examples thereof, but rather, should be fully commensurate with that of the claims appended hereafter and their functional equivalents.

What is claimed is:

1. A method for mitigating temperature of a device, the method comprising:

receiving a signal from a temperature sensor, wherein the temperature sensor is disposed within the device having a processor chip that produces heat within the device, generating temperature data from the signal;

processing the temperature data to generate data indicative of a temperature of an external surface of the device, wherein processing the temperature data includes

applying a low pass filter, an amplitude attenuation, and a delay to the temperature data; and

reducing an operating parameter of the processor chip in response to the data indicative of the temperature of the external surface of the device.

2. The method of claim **1**, wherein the temperature sensor is disposed in at least one of the following locations within the device:

in the processor chip;

in a package including the processor chip, where the package includes a dielectric substrate on which the processor chip is mounted; and

on a Printed Circuit Board (PCB) on which the package is disposed.

3. The method of claim **1**, wherein the signal indicates a resistance associated with the temperature sensor.

4. The method of claim **1**, wherein the temperature sensor comprises a thermistor.

5. The method of claim **1**, wherein reducing the operating parameter of the processor chip comprises:

comparing the data indicative of the temperature of the external surface of the device to a threshold temperature, the threshold temperature representing a maximum allowed temperature of the external surface of the device.

6. The method of claim **1**, wherein the method is performed by a software kernel of the processor chip of the device.

7. The method of claim **1**, wherein reducing an operating parameter of the processor chip comprises:

reducing an operating frequency of the processor chip.